

## **SECTION SIX: MAINTENANCE, SERVICE AND TROUBLESHOOTING**

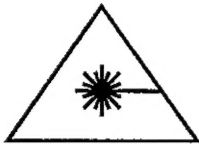
### **Maintenance/ Service**



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The maintenance and/or service of the laser must be performed either by Coherent personnel or by persons authorized by Coherent. Maintenance and/or service by unauthorized persons results in all warranties being voided. Coherent assumes no liability for any damages and malfunctions caused by disregarding or ignoring this information.

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When performing any service procedures, always make sure that the entire area is secured against unauthorized persons being present (e.g. with a chain and warning sign).

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Always wear appropriate eyewear while performing these procedures.

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## Maintenance Timetable

*Table 6-1. Maintenance Timetable*

IDENTIFICATION	DATE	EXPLANATION
Cooling Water	Monthly	Check the water level and if necessary, replenish the water tank.
Water Flow	Monthly	Check the water flow as described in "Checking the Water Flow" on page 6-3.
Laser Status Lamps	Daily	Set the laser system to System Ready and check whether the laser status lamps on the laser head and the additionally installed lamp of the integrator are lit and are clearly visible.

## Service Timetable

*Table 6-2. Service Timetable*

IDENTIFICATION	HOURS	EXPLANATION
Laser Output Window	10,000 h	The laser output window must be exchanged to guarantee constant laser parameters.
Laser Diodes	10,000 h	The laser diodes must be exchanged to guarantee constant laser parameters.
Water Filter	10,000 h	Exchange the water filter to guarantee cleaned cooling water.
Water Pump	20,000 h	The pump head must be replaced to guarantee trouble-free operation of the cooling system.

## Cooling Water Refill

The water circulation inside the supply unit is a self-contained system. Excessive loss of cooling water represents an abnormal condition, which may indicate a leak in the system.

The cooling water level might become insufficient during the operation of the laser. To add water refer to "Refilling the Cooling System" on page 3-2.

## **Checking the Water Flow**

### **Procedure**

1. Start up the laser and wait until the system has reached the Laser Ready state.
2. Check the water flow via the RS-232 interface (refer to Table 5-16, "Queries," on page 5-45).
3. If the water flow is less than 3.5 liter/minute, inform the Coherent service department.

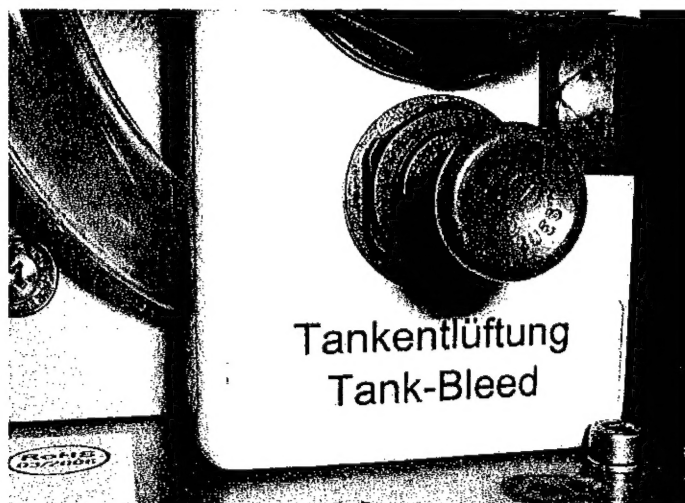
## **Checking the Water Level**

### **Required Tools and Materials**

- Open-end wrench, size 18 mm and 20 mm

### **Procedure**

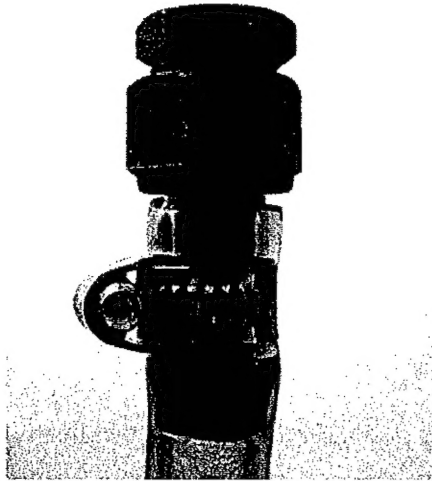
1. Turn the main switch to position 0.
2. Turn the keyswitch to position 0 and remove the switch.
3. Take off the sealing plug from the tank bleed, by pressing the black ring and pulling the sealing plug at the same time (Figure 6-1).



*Figure 6-1. Removing the Tank Bleed Cap*

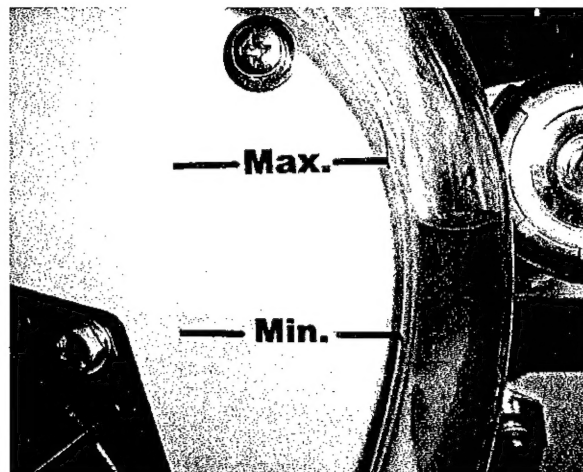
4. Remove the refill tube from the clamps.

5. Use an open-end wrench to remove the cap of the refill tube (Figure 6-2).



*Figure 6-2. Removing the Refill Tube Cap*

6. Check the water level in the refill tube against the Min/Max. marking at the cooling housing (Table 6-3).



*Figure 6-3. Min/Max Water Level*

- a.) If the water level is between the Min./Max. marking, the level is o.k. Proceed to step 7.

### *Maintenance, Service and Troubleshooting*

- b.) If the water level is below the Min. marking, refill the water as described in “Refilling the Cooling System” on page 3-2.
  - c.) If the water level is above the Max. marking, inform the Coherent service department.
7. Replace the cap on the refill tube.
  8. Stick the tube back into the clamps.
  9. Close the tank-bleed with the sealing plug.
  10. Prior to taking the laser into operation, ensure that no water has been spilled. However, if spillage has occurred contact the Coherent service department.

## **Cleaning and/or Exchanging the Laser Output Window**

During laser system operation, the output power and the quality of the beam profile can decrease. This might be caused by one or both of the following conditions:

- The laser output window (anti-reflective coating on either side) at the laser aperture is dirty.
- The laser diodes are damaged.

If the cause is unclear, inspect the laser output window first. If the laser output window is not the reason for the power/quality loss, the laser diodes have to be replaced.

### **Required Tools and Materials**

- Allen key (size: 2.5 mm)
- Gloves
- Cleaning cloth
- Acetone
- Tweezers
- Laser output window (spare part by Coherent)
- O-ring for output window (spare part by Coherent)

### **Preparation**

- Make sure that the Main Switch is in the Off position.
- Ensure that access to the front of the laser head is possible.



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**Make sure that the Main Switch is in the Off position. Then secure the system against an inadvertent restart, i.e. by securing the Main Switch or unplugging the X100 (interlock circuits). Switch the keyswitch off and remove the key.**

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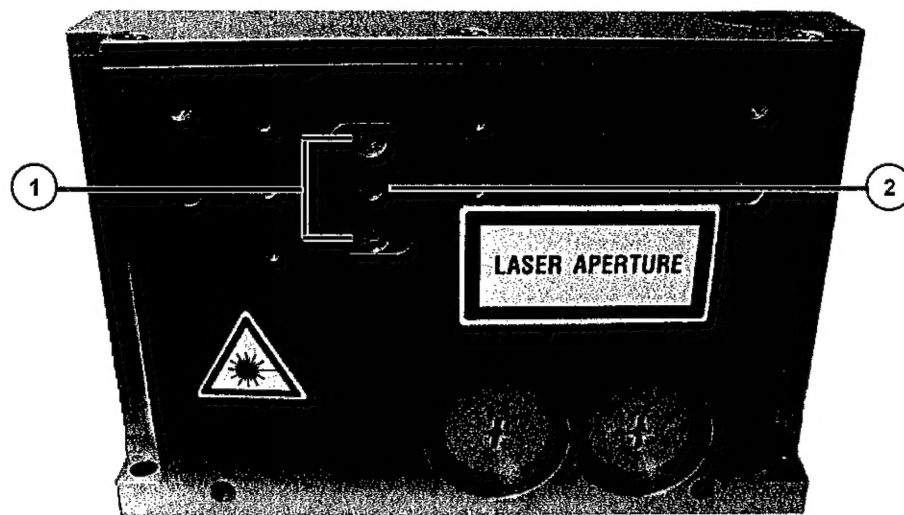


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**The laser head should only be opened in a clean laboratory environment.**

**Do not keep the laser head open for more than one minute. Dirt and humidity might otherwise decrease the beam quality and profile.**

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1. Allen Screws (M3)

2. Laser Output Window

*Figure 6-4. Laser Output Window at the Beam Aperture*

#### Procedure

1. Unscrew the adjustment beam expander.
2. Unscrew both Allen screws, which fix the laser output window at the laser aperture to its place.
3. Remove the small component containing the laser output window.
4. Detach the laser output window out of the anchor and pay attention not to lose the O-ring.
5. Clean or replace the laser output window.
  - a.) Wear gloves.
  - b.) To clean the laser output window, put some drops of acetone onto the optical.
  - c.) Carefully place the cleaning cloth onto the optical and clean it slowly with one swipe.
  - d.) To replace the laser output window, remove it from its package and inspect it to ensure cleanliness.
6. Make sure the O-ring between the laser output window and the laser head is still in its place and put the optical into its anchor.
7. Fix the anchor to its original position with Allen screws.
8. Screw the adjustment beam expander back to its original position.

## Replacing Laser Diodes

If a faulty laser output window is not the reason for a power/quality loss of the laser output, the laser diodes must be replaced.



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**Replacement of the laser diodes must be done by Coherent service or an authorized person only.**

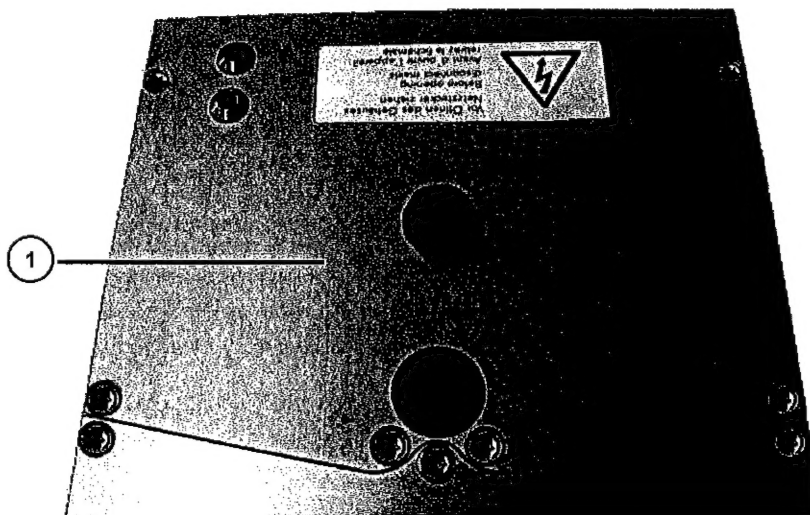
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### Required Tools and Materials

- Flat wrench (size: 5.5 mm, 8 mm)
- Allen key (size: 2.5 mm, 3 mm)
- Torque screw driver (size: TX 20)
- Short circuit clamps for the laser diodes (found later in the Laser Diode Chamber)
- Flat pliers
- Laser diodes with Indium foil

### Preparation

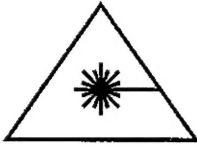
- Make sure that the Main Switch is in the Off position.
- Ensure that access to the top and the back of the laser head is possible.



1. Chamber of the Laser Diodes

*Figure 6-5. Laser Diode Chamber*





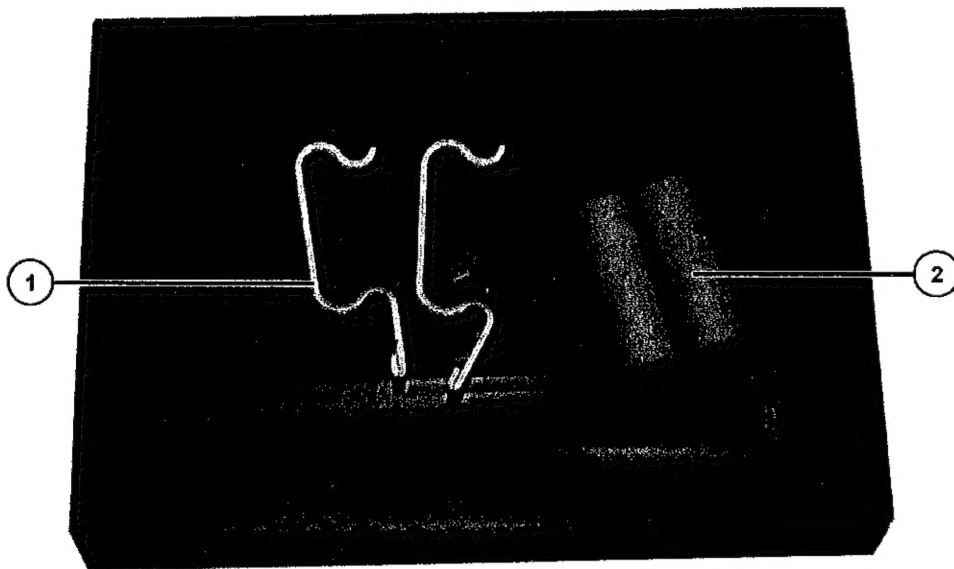
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Make sure that the Main Switch is in the Off position. Secure the system against an inadvertent restart, i.e. by securing the Main Switch or unplugging the X100 (interlock circuits). Switch the keyswitch off and remove the key.

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#### Procedure

1. Remove the rear top cover (containing the laser-ready LEDs).
2. Remove the upper back cover above the wiring connections.
3. When turning over the removed cover plate, a black box will be seen. Inside the box are found short circuit clamps for the laser diodes and protective caps for the connection of the phases.



1. Short Circuit Clamps for Diodes

2. Protective Caps for the connection of the phases

*Figure 6-6. Tool Box for Diode Exchange*

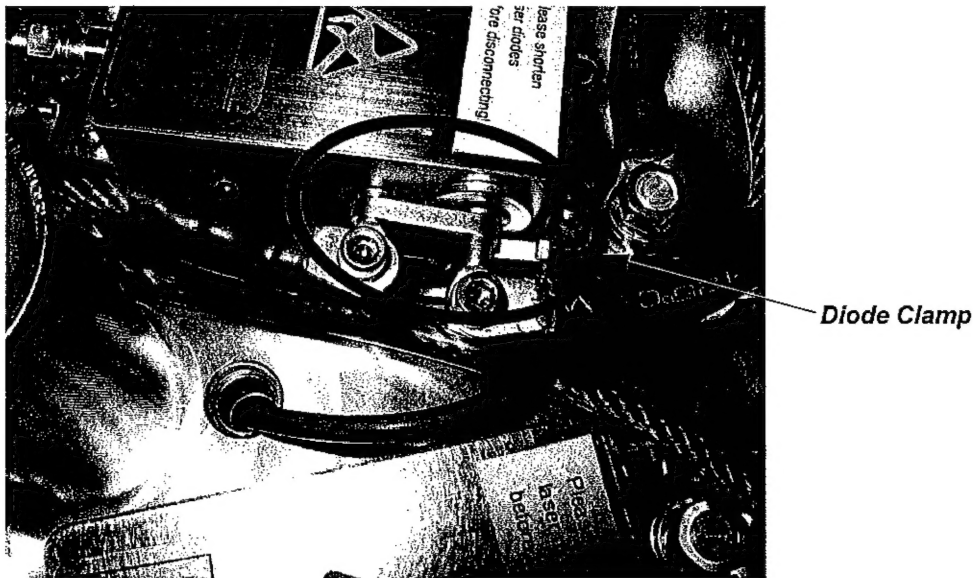


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Laser diodes are susceptible to electrostatic discharge. Use sufficient grounding techniques, such as wearing a ground strap, throughout the remaining steps of this procedure.

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4. Short-circuit the respective laser diodes with a short circuit clamp.



*Figure 6-7. Diode Clamp Mounted*

5. Remove the cables connected to the laser diode, except the short circuit clamp.



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**Be careful not to touch the face of the FAP nose. Remove the four screws fixing the laser diode.**

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6. Detach the SMA connector.
7. Carefully remove the laser diode from the back of the laser head.
8. Remove the remains of the old indium foil.
9. Replace the old indium foil with new foil.
10. Place the new diode in the new position.
11. Tighten SMA connector screws by hand only.
12. Affix the laser diode with the four screws on the copper block.
13. Screw the cable to the laser diode.
14. Remove the short circuit clamp.
15. Attach the covers of the laser head.

## **Exchanging the Water Filters (Exchanging the Chiller)**

If an inspection of the water filters indicates contamination, the water filter must be cleaned or exchanged.

### **Required Tools and Materials**

- Screw driver for hexagon head (M 5.5)
- Allen key (size: 3 mm)
- Small screw driver for slotted head screws
- Compressed air bottle

### **Preparation**

- Verify that the Main Switch is in the Off position.
- Ensure that access to both sides of the supply unit, as well as to the back of it, is possible. For possible ease of access, the cooler plate is to be pulled out by approx. 30 cm or completely for exchanging the chiller.



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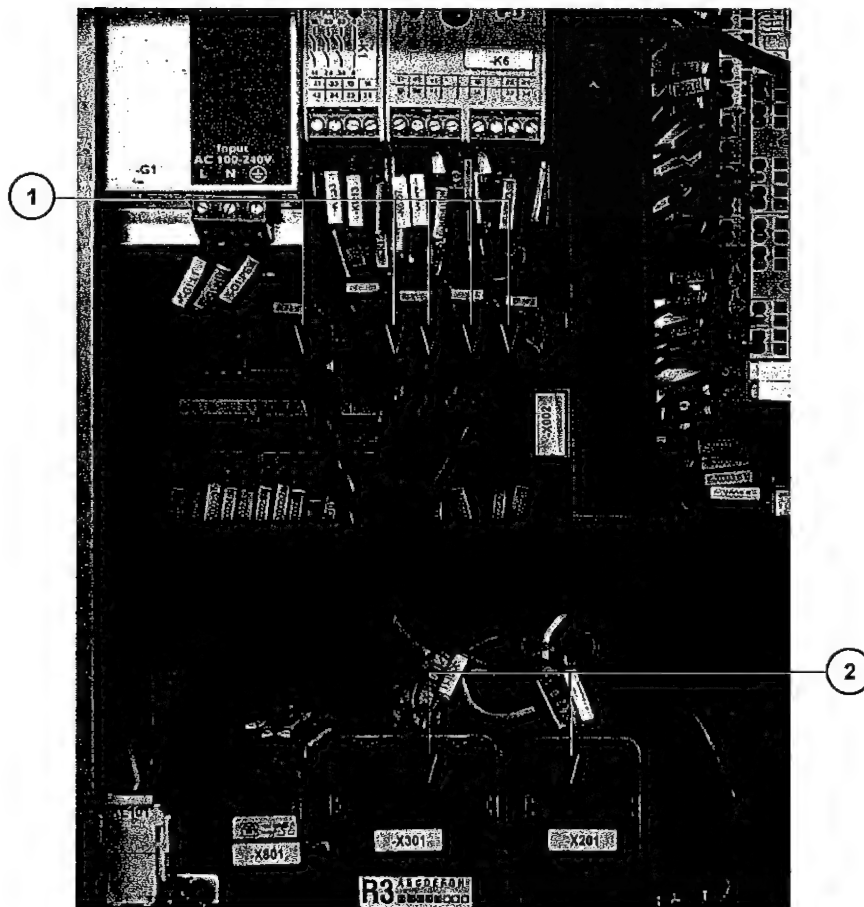
**Verify that the Main Switch is in the Off position. Secure the system against an inadvertent restart, i.e. by securing the Main Switch or unplugging the X100 (interlock circuits). Switch the keyswitch off and remove the key.**

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### **Procedure**

1. Empty the water from the water circulation unit. Refer to “Emptying the Cooling Water from the Laser System” on page 3-13.
2. Unscrew the left- and right-side cover of the supply unit.
3. Unscrew the front top cover.
4. Remove the covers.

5. Disconnect the plugs (see Figure 6-8) from the electric board, which are accessible by removing the front top cover.

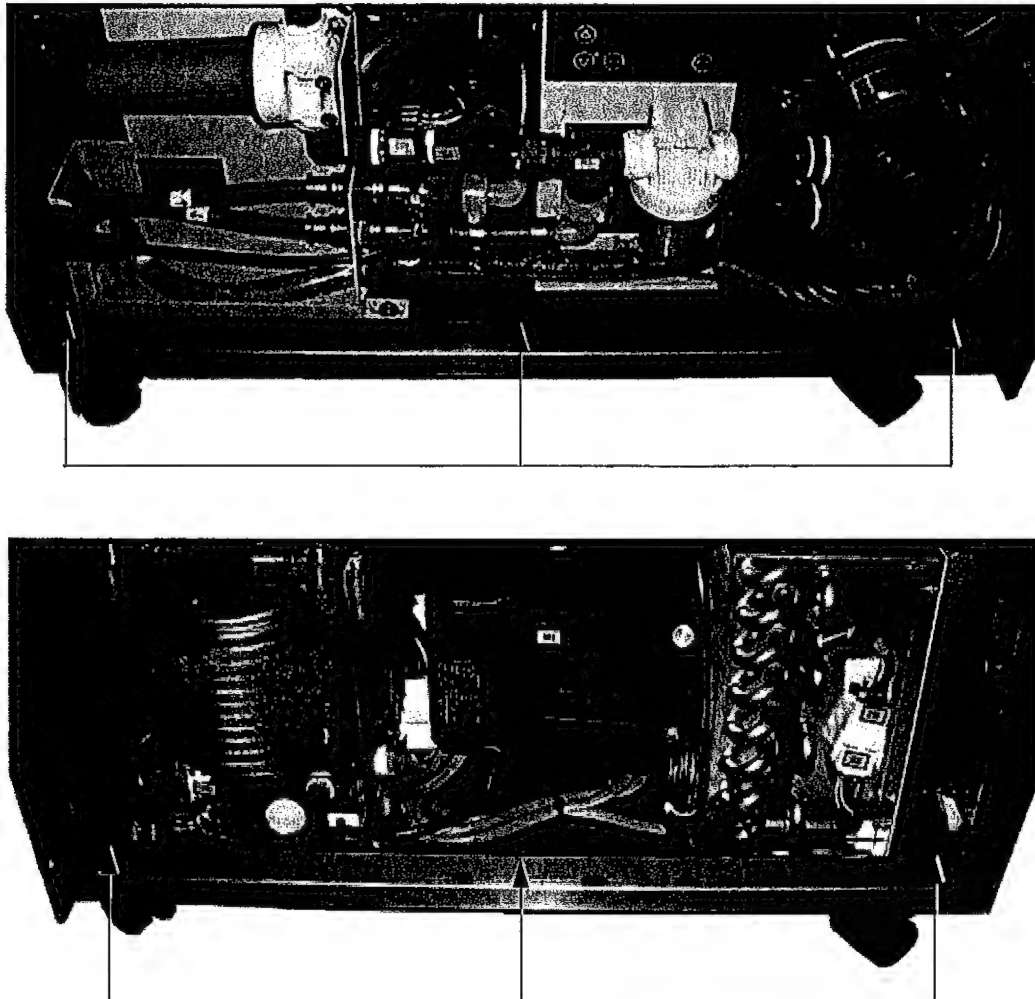


1. Cables from Chiller to the Electric Board

2. Connectors from Electric Board to the Front Panel

**Figure 6-8. Connectors of the Cooler Plate**

6. Unscrew the six screws (three on each side), which fasten the cooler plate to the frame of the supply unit.



*Figure 6-9. Attachment Screws of the Cooler Plate*

7. Carefully pull the cooler plate out of the back side of the supply unit until the filter is accessible.

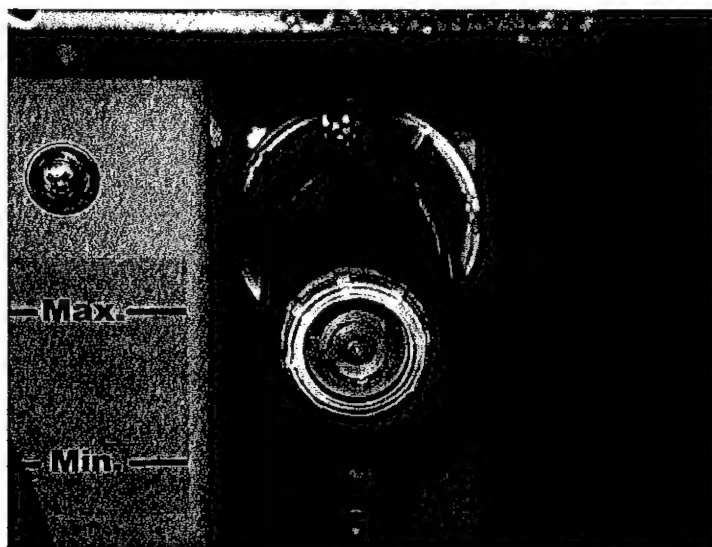


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When removing the cooler plate, be aware of the plugs leading from the cooler plate to the electric board; do not let them get wet!

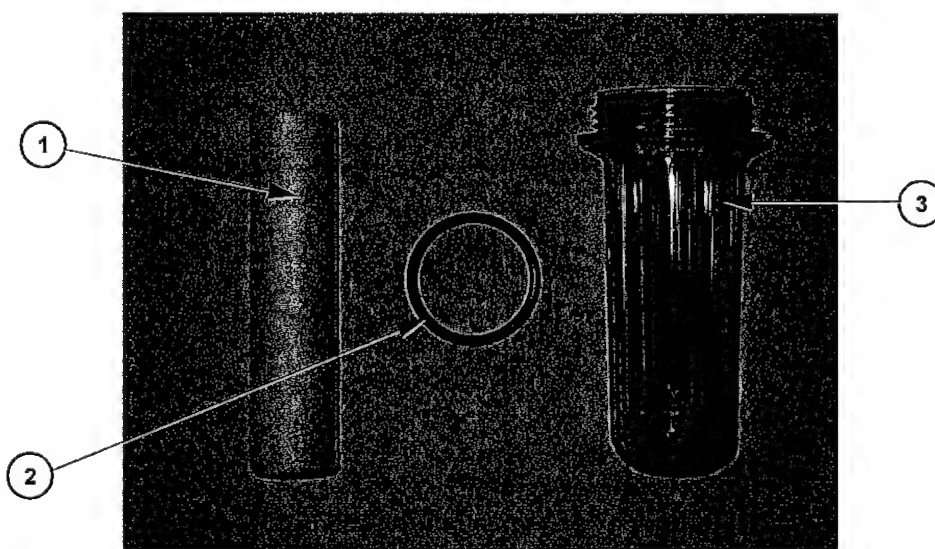
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8. Unscrew the small transparent water filter case as shown in Figure 6-10.



*Figure 6-10. Water Filter Case (Top View)*

9. Remove the filter inlay.
10. Insert the new filter cartridge.



1. Water Filter

2. Seal Ring

3. Water Filter Case

*Figure 6-11. Individual Parts of the Water Filter*

11. Screw on the transparent cartridge again, being careful to ensure the cartridge is in correct position with respect to the seal ring inside of it.
12. Push the cooler plate carefully back into the supply unit.
13. Re-fasten the cooler plate with the six screws.
14. Plug all connectors connecting the cooler plate and the electric board back into their previous positions in the opposite order from which they were removed.
15. Mount all outer covers back onto the supply unit.
16. Refill the water inside the water circulation as detailed in "Refilling the Cooling System" on page 3-2.

### **External Visual Inspection**

Periodically perform a visual inspection of the laser enclosure ensuring that no enclosure parts are loose or distorted and that the emission indicator lights are functioning properly. Also, make sure that no labels are missing or are unreadable; if so, replace them.

### **Cleaning**

If necessary, wipe the supply unit clean with a soft, dry cloth.

### **Error and Warning Responses**

The Prisma reports short error and warning keywords to the display of the soft key control.

Table 6-3 provides an overview of these error commands.

### **Error Keywords**

In case of a malfunction of the system, an error message is displayed on the soft key control display and can additionally be requested by a PC connected to the RS-232. Table 6-3 provides a list of these error keywords.

If an error occurs, the laser operation will stop automatically and the soft key control will display a blank screen with the respective error keyword. Before restarting the laser, the error source must be eliminated. To restart the laser system, send the "System Enable" command via User Interface or turn the keyswitch to position 0 and back to position I if not said otherwise.

**Table 6-3. Error Commands**

ERROR KEYWORD	DESCRIPTION & FAILURE CORRECTIVE ACTION
DPS Not Ready Error	Normally, the DPS sends a signal when it's okay. This signal was not sent. This can result from a damaged DPS.
DPS High Current Error	When this error occurs, the current reported by the DPS is more than 5 A above the maximum value. --/-- Check the calibration of the DPS, otherwise the DPS is damaged.
DPS Temperature Error	The DPS is overheated. This can result from a damaged DPS.
ES Relay Error, ES Relay or Temperature Interlock Error	The Emergency Stop relay (K1) has been released. The interlock circuits for the external ESD circuits are not closed. This can have two different reasons. First, check where the circuits are interrupted and eliminate the source of error. The connection to the laser can be found at the interlock connector (X 100) between pin 1 and pin 2, as well as pin 3 and pin 4 for the external ESD circuit and between pin 7 and pin 8, as well as pin 9 and pin 10 for the external shutter interlock circuit. When the source of the error has been eliminated, the laser system will automatically restart with the warm up. Second, the contactors K2 and K3 have been released at the same time; in this case, turn off the Main Switch to Off and afterwards to On to restart the laser system for further diagnoses. The contactor K2 can't be activated. This can be due to a laser head temperature > 40°C. --/-- Contact Coherent service. When the source of error has been eliminated, the laser system will automatically restart.
External Interlock Error	The contactor K3 can't be activated. The reasons therefore are external conditions. --/-- Check if all external contacts are closed. The connection to the laser is on the 12 pin Interlock connector X100 between pin 11 and 12 onto the interface panel. When the source of error has been eliminated, the laser system will automatically restart.
Flow Error	The water flow inside the cooling system dropped below a predefined value and is therefore not sufficient to reduce the heat. The standard value is 3.0 l/min., but depending on the laser system it may be changed. For deviations on the laser system, ask Coherent service. Check to see if the water filter inside the cooling system must be replaced (refer to "Cleaning and/or Exchanging the Laser Output Window" on page 6-6). Further causes of fault can be due to a kinked tube leading to the laser that must be straightened or a damaged pump that must be replaced.



Table 6-3. Error Commands (Continued)

ERROR KEYWORD	DESCRIPTION & FAILURE CORRECTIVE ACTION
High Temperature Error	<p>The temperature of the cooling water is at least 3°C above the preset operation temperature. The error will disappear when the temperature is only 2°C above the preset operation temperature.</p> <p>This can result from wrong ambient temperature because an ambient temperature below 42°C (107.6°F) is recommended.</p> <p>Additionally, it can be a damaged hot gas bypass valve or a damaged cable leading to the temperature sensor.</p>
Low Temperature Error	<p>The water level inside the cooling system is too low to cool the laser components sufficiently.</p> <p>This can result from wrong ambient temperature because a temperature above 15°C (59°F) is recommended.</p> <p>Additionally, it can be a damaged heating gas bypass valve or a damaged cable leading to the temperature sensor.</p>
Low Water Error	<p>The water level inside the cooling system is too low to cool the laser components sufficiently.</p> <p>Check the cooling system and all water connections for leaks.</p> <p>When the source of error has been eliminated, the Main Switch must be used to restart the laser system.</p>
QSD Error	<p>Normally, the QSD sends a ready signal when it is okay. This signal was not present and can be the result from a damaged QSD. Contact Coherent service.</p>
Software System Error	<p>An internal software error occurred.</p> <p>--/--.</p> <p>Contact Coherent service.</p> <p>When the source of error has been eliminated, the Main Switch must be used to restart the laser system.</p>
Start Error 1	<p>The contactor K2 or K3 stay activated even when the laser system is switched off.</p> <p>A possible reason could be a stuck contactor.</p>
Temperature Out of Range Error	<p>The temperature of the laser is below 11°C or above 45°C.</p> <p>--/--.</p> <p>Check the temperature conditions of the operation place.</p>

## Warnings

When a warning condition is detected in the laser system, a warning message is displayed on the soft key control display and can additionally be requested by a PC (warning keyword) connected to the RS-232.

If a warning occurs, the laser will still continue operation, but the active warning will be displayed by a small keyword. When more warnings occur, each warning will be displayed by the warning keyword for two seconds before it is replaced by the next one. If a warning condition no longer exists, the warning will not be shown.

**Table 6-4. Warnings**

WARNING KEYWORD	DESCRIPTION & FAILURE CORRECTIVE ACTION
DPS high current warning	The DPS provides the laser diodes with a current that is 3 A above the preset value. Check the calibration of the DPS, otherwise the DPS is damaged.
DPS high voltage warning	The DPS provides the laser diodes with more voltage than the expected value. Check the calibration of the DPS, otherwise the laser diodes or the DPS is damaged. The maximally allowed deviation of the voltage depends on the number of laser diodes and are the following: 1 diode (3.42V), 2 diodes (5.24V), 3 diodes (7.06V), 4 diodes (8.88V).
DPS low current warning	The DPS provides the laser diodes with a current that is 3 A below the preset value. This can result from a damaged DPS or wrong calibration of the DPS.
DPS low voltage warning	When this warning occurs, the DPS provides the laser diodes with less voltage than the expected value. --/-- Check the calibration of the DPS, otherwise the laser diodes are too old, are short-circuited or the DPS is damaged. The minimum DPS output voltage depends on the number of laser diodes and are the following: 1 diode (1.42V), 2 diodes (3.24V), 3 diodes (5.06V), 4 diodes (6.88V)
Flow warning	When this warning occurs, the flow of the cooling water is lower than expected. --/-- Check the filter inlay inside the cooling circuit or eventually replace the cooling water with new one. Contact Coherent service to check the pump.
High temperature warning	The temperature of the cooling water is more than 1.0°C above the operation temperature. This can result from wrong ambient temperature or a damaged cooling system. This warning will be eliminated when the deviation of the operation temperature is within 0.5°C.

**Table 6-4. Warnings (Continued)**

WARNING KEYWORD	DESCRIPTION & FAILURE CORRECTIVE ACTION
Low temperature warning	The temperature of the cooling water is more than 1.0°C below the operation temperature. This can result from wrong ambient temperature or a damaged cooling system. This warning will be eliminated when the deviation of the operation temperature is within 0.5°C.
Low water warning	The cooling water is sinking to a level insufficient to cool the laser components. Check system for leaks.
Runtime NV data corruption warning	A mistake in the software programming occurred. --/-- Cycle power. Attempt to restart laser system. If restart fails, contact Coherent service.
Shutter interlock warning	The shutter interlock contactor K6 was released, even if it wasn't steered so by the keyswitch. Check for the interlock lines connected via X100.
Shutter not open warning	The shutter is supposed to be open, but it isn't. --/-- The wiring leading to the shutter must be checked by authorized service personnel.
Shutter timeout warning	The shutter is responding too slowly to actions. --/-- This may be the result of an abrasion, as the shutter needs more time than 450 ms to fulfill the request. Contact Coherent service.
SWR warning (SWR = <u>S</u> tanding <u>W</u> ave <u>R</u> esonance)	The RF cable leading from the QSD to the Q-Switch inside the laser head is damaged or the Q-Switch is damaged. Check for loose RF connection in the power supply, otherwise the QSD is damaged; contact Coherent service. Check if the BNC cable at the QSD (Q-Switch driver) has a loose contact. If not, make sure that the 9 pin cable leading to the QSD is okay (in particular pin 7), otherwise the QSD is damaged.

